

NOTES ON THE FAMILY ALEYRODIDAE AND ITS SUBFAMILIES:
REDESCRIPTION OF THE GENUS *ALEUROCYBOTUS* QUAINANCE AND
BAKER AND DESCRIPTION OF *VASDAVIDIUS*, A NEW GENUS
(HOMOPTERA: ALEYRODIDAE)

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Abstract.—The author, publication date, type genus and type species are given for the whitefly family Aleyrodidae. The five subfamilies proposed for the Aleyrodidae are discussed briefly. *Aleurocybotus* Quaintance and Baker 1914, type species *Aleurodes graminicola* Quaintance 1899, is redescribed. *Vasdavidius*, new genus, is established with *Aleurocybotus indicus* David and Subramaniam 1976 the type species. As recognized here, species included in *Aleurocybotus* are New World forms and those in *Vasdavidius* are Old World species placed erroneously in *Aleurocybotus*. Keys are included for the adults and pupal cases of the subfamilies of Aleyrodidae and for separating the adults and pupal cases of *Aleurocybotus* and *Vasdavidius*. The characteristics of the antennae and feet of adults of *Aleurocybotus* differ greatly from those of other known genera of Aleyrodidae.

Key Words: Aleyrodidae, subfamilies, *Aleurocybotus*, *Vasdavidius*, adults, pupal cases, antennae, feet

This article on whiteflies provides information that seldom appears in print and that is not readily available in the literature, i.e., the authors and dates of publication of the genus *Aleurodes*, the subfamily Aleyrodinae, and the family Aleyrodidae. The five subfamilies proposed for the Aleyrodidae are considered, and keys are prepared for adults and pupal cases of the two subfamilies that here are considered valid.

The genus *Aleurocybotus* Quaintance and Baker (1914) is discussed and unique structures of the adults show clearly that knowledge of this stage, as well as pupal cases, must be known before accurate relationships of whiteflies can be determined. A new genus, *Vasdavidius*, is established for five species currently placed in *Aleurocybotus* and differences between *Aleurocybotus* and the new genus are discussed.

Thus, the objectives of this paper are: 1) To provide definitive information on the authorship of the family group name Aleyrodidae; 2) to discuss the validity of the names of the current subfamilies within the Aleyrodidae and to present a key to the valid subfamilies using adults and pupae; 3) to discuss the unique characteristics of the adults of *Aleurocybotus*; and 4) to describe a new genus for five species previously placed in *Aleurocybotus*.

AUTHORSHIP OF THE ALEYRODIDAE

In a search of the literature of the past one hundred years, I found only two early references and two recent papers that cited the correct author. In the older literature Cockerell (1902) wrote "Family Aleyrodidae, Westwood 1840" and Quaintance and Baker (1913) cited "Family Aleyrodidae

Westwood." Recently Jesudasan and David (1991) and Regu and David (1993) wrote "Family Aleyrodidae Westwood, 1840." In the years between 1913 and 1991 authorship of the family was either not given or was given incorrectly. For example, the aleyrodid catalog of Mound and Halsey (1978) did not list the author of the family. Even when Cockerell (1902) and Quaintance and Baker (1913) stated correctly that Westwood was the author, they did not explain that he had described it in a cryptic, disjunct way and had made authorship difficult to determine.

Confusion surrounding the authorship of the family name Aleyrodidae apparently is caused by the way that it was described. Study of Westwood (1840) shows that he first used the name of the family on page 435 in the following statement "The section consists of the families Psyllidae, Aphidae, and Aleyrodidae; the genus *Aleyrodes* disagreeing so much from the Aphidae, in which it is placed by Latreille, and from the Coccidae in which Burmeister arranges it, that I have thought it most natural to consider it as forming a distinct family." Although Westwood first used the name on page 435, he did not validate it with a description until pages 442 and 443. Apparently most workers did not connect between the first use of the name and its actual description.

Aleyrodes, the type genus of Aleyrodidae, was described by Latreille (1796: 93) and later (1801–1802: 264) he designated *Phalaenia (Tinea) proletella* L. as the type species of the genus (Mound and Halsey 1978).

SUBFAMILIES OF THE ALEYRODIDAE

Five subfamilies have been established for the Aleyrodidae. Aleyrodinae Westwood (1840) and Aleurodicinae Quaintance and Baker (1913) are considered valid. Udamoselinae Enderlein (1909), Uraleyrodinae Sampson and Drews (1941) and Siphonaleyrodinae Takahashi (1932) are unacceptable for different reasons.

The author of family-group names based on the genus *Aleyrodes* has not been clear. Article 36.1 of the *International Code of Zoological Nomenclature* (1999) indicates clearly that, by the principle of coordination, Westwood (1840) is the author of Aleyrodinae and all other family-group names based on the genus *Aleyrodes*.

Enderlein (1909), in a key, included Aleurodinae without an author's name. Since 1909 most workers, including Quaintance and Baker (1914, 1917), Bondar (1923) and Mound and Halsey (1978), have continued to cite Aleurodinae or Aleyrodinae without an author's name. Sampson (1943, 1944), Sampson and Drews (1941, 1956), and Jesudasan and David (1991) cited Enderlein (1909) as the author of Aleyrodinae but that action was incorrect. The first valid description of an aleyrodid family-group name was by Westwood (1840) who named and described the Aleyrodidae.

Quaintance and Baker (1913) established Aleurodicinae and designated *Aleurodicus* Douglas (1892) the type genus. Quaintance (1908) designated, as type of the genus, *Aleurodicus anonae* Morgan (1892) which is now considered a synonym of *Aleurodicus cocois* Curtis (1846) (Mound and Halsey (1978), Martin (1997)).

Enderlein (1909) established Udamoselinae, designated *Udamoselis* the type genus, and *pigmentaria* the type species. He described the species from a single adult male and based the subfamily largely on wing venation. Udamoselinae was recognized by Quaintance and Baker (1913), Sampson and Drews (1941), and Sampson (1943, 1944). Solomon (1935) indicated that *Udamoselis* was similar to *Synaleurodicus* Solomon (1935) and should be placed in Aleurodicinae. Mound and Halsey (1978), however, stated that "because the pupal case of *Udamoselis* is unknown, the name is treated here as a *nomen dubium* in order to remove the subfamily name from synonymy." Mound and Halsey also regarded *Udamoselis pigmentaria* "as *nomen dubium* because it is unlikely that the orig-

inal description of the unique, adult male will ever be applicable with certainty to any specimens which may be collected in the future."

Sampson and Drews (1941) erected the subfamily Uraleyrodoxinae, designated their new genus *Uraleyrodes* the type genus and their new species *U. ceriferus* the type species. Mound and Halsey (1978) synonymized *Uraleyrodes* with *Aleurocerus* Bondar (1923). The original authors based the subfamily on characteristics of the pupal case. Russell (1986) studied adults of *U. ceriferus* and found that this species belongs in the Aleyrodinae as that subfamily is now understood.

Takahashi (1932) erected the subfamily Siphonaleyrodoxinae, designated his new genus *Siphonaleyrodes* the type genus and his species *formosanus* the type species. It is clear from its description and illustration that *S. formosanus* is a psyllid (superfamily Psylloidea) nymph. Based on the description and illustration of Boselli (1930) in comparison with the information provided by Takahashi (1932) Mound and Halsey (1978) synonymized *Siphonaleyrodes* with *Trioza* and Siphonaleyrodoxinae with Trioziinae. Through the courtesy of Man-Miao Yang, National Museum of Natural Science, Taichung, Taiwan, I looked at a slide-mounted mature nymph of *Trioza cinnamomi* from *Cinnamomum reticulatum* and it agrees well with the illustration and description of Takahashi (1932).

The subfamilies that are valid can be separated by the following keys.

KEY TO ADULTS OF SUBFAMILIES

- 1. Forewing usually with more than two veins; paronychium a spine Aleurodicinae Quaintance and Baker
- Forewing usually with one or two veins; paronychium not a spine, blade-like and smooth, or typical paronychium absent and a modified tarsal appendage present . . . Aleyrodinae Westwood

KEY TO PUPAL CASES OF SUBFAMILIES

- 1. Leg ending in a claw; dorsum usually with compound pores but these sometimes absent

- and agglomerate pores present
- Aleurodicinae Quaintance and Baker
- Leg ending in a disk; dorsum without compound pores and the type of agglomerate pores of the Aleurodicinae . . . Aleyrodinae Westwood

A DISTINCTIVE WHITEFLY GENUS

Aleurocybotus Quaintance and Baker (1914), type species *Aleurodes graminicola* Quaintance 1899, is distinctive because of the unique structure of the antennae and feet of the adults. The antennae end in a delicate membrane that usually is destroyed when specimens are placed in chemicals before being mounted on slides. The membrane was reported by Poinar (1965). In the male, antennal segment VII also has two slender filaments and it is longer than segments III-VI combined. In the female, antennal segment VII has only one filament, but it also has a long sensory seta, and segment VII is shorter than segments III-VI combined. The feet of adults of *Aleurocybotus* have only one smooth, normal claw. In place of a second claw there is a claw-shaped appendage which appears fleshy, has minute, scattered spinules, and a seta on its margin. If this structure represents the paronychium of other aleyrodids, it is remarkably modified from other known paronychialia. I have not observed these characteristics in the antennae or feet of other described whiteflies but I have seen similar structures of the antennae and feet of two undescribed species from the United States. However, these species do not fit in *Aleurocybotus* because the pupal characters are quite different; they represent an undescribed genus.

I have examined more than five hundred whitefly adults representing at least fifty percent of the described genera of whiteflies, and have found only the two species mentioned above that appear to be closely related to *Aleurocybotus*. If adults and pupal cases of most genera of the Aleyrodinae were known, it might be desirable to separate such distinctive groups as *Aleurocybotus* into subfamilies or other higher groups. In the present limited knowledge,

however, it is not desirable to describe a higher-level taxon.

KEY TO ADULTS OF *ALEUROCYBOTUS* AND *VASDAVIDIUS*

- 1. Antenna ending in a delicate membrane and one or two slender filaments; feet with one smooth, normal claw and a claw-shaped appendage that appears fleshy, with minute scattered spinules and a seta on the margin (Fig. 2) *Aleurocybotus* Quaintance and Baker
- Antenna without a membrane and filaments; feet with two smooth, normal claws, and a paronychium between claws (Fig. 4) *Vasdaavidius*, new genus

KEY TO PUPAL CASES OF *ALEUROCYBOTUS* AND *VASDAVIDIUS*

- 1. Antenna of male and female extending to or beyond posterior margin of foreleg, antenna of male longer than antenna of female, all or most of antenna adjacent to or just laterad of legs; New World *Aleurocybotus* Quaintance and Baker
- Antenna of male and female not extending posterior to foreleg, apparently of nearly equal length, all or most of antenna under foreleg; Old World *Vasdaavidius*, new genus

DESCRIPTIONS

Genus *Aleurocybotus* Quaintance and Baker

Aleurocybotus Quaintance and Baker 1914: 101, 1917: 356.

Type species.—*Aleurodes graminicola* Quaintance (1899) by original designation and monotypy.

Females larger than males.

Adults.—Body slender, pale yellow or dorsum tinged with brown or red.

Head: Each compound eye divided by a narrow space; facets nearly identical in size and shape. An ocellus adjacent to margin of upper part of each compound eye. Distal rostral segment as wide as long, with two pairs of minute setae. Antennal segment VII longer than segments III to VI combined in males, shorter than segments III to VI combined in females, ending in a thin membrane with two slender filaments in male (Fig. 1), one slender filament and one sen-

sory seta in female; one or more of segments III to VI with one or more sensoria.

Thorax: Wings pale, radial sector present. Legs with coxae, trochanters, femora, tibiae and two-segmented tarsi; hind tibia with a row of setae; foot with one smooth, normal claw and a claw-shaped tarsal appendage, it appears fleshy with minute, scattered spinules, a slender seta on margin; without a typical paronychium (Fig. 2).

Abdomen: Area around vasiform orifice slightly sclerotic. Vasiform orifice as wide as long, posterior end closed. Operculum quadrate or wider than long. Lingula spatulate, extending beyond orifice. Valves of female ovipositor slender near pointed tips. Claspers of male rather slender, pointed apically, with a few slender setae. Aedeagus tapered from base to apex.

Pupal case.—Pale yellow, often with shades of brown or red, or colorless. Elliptical or subelliptical in outline. Transparent, colorless wax on dorsum and venter; translucent, white wax encircling swollen venter of mature pupal case.

Margin: Dentate. Anterior and posterior setae present, or anterior pair not observed. Tracheal pores absent.

Dorsum: Smooth or slightly sculptured, membranous or slightly sclerotized, flat or with amedian rachis on abdomen. Submedian depressions and pockets present. Eight segments present in median area of abdomen. Median and transverse molting sutures reaching body margin, transverse suture curved slightly caudad from its midpoint, recurved and reaching body margin slightly anterior to a point opposite its midpoint. Disk pores and associated porettes present. Cephalic setae present, first abdominal setae present or absent, eighth abdominal and caudal setae present; usually one pair of submarginal setae on each segment of thorax and on three or more abdominal segments, subdorsal or submedian minute setae or setal bases sometimes present on thorax and abdomen. Vasiform orifice cordate, subcordate or subtriangular, posterior end closed. Operculum wider than long.

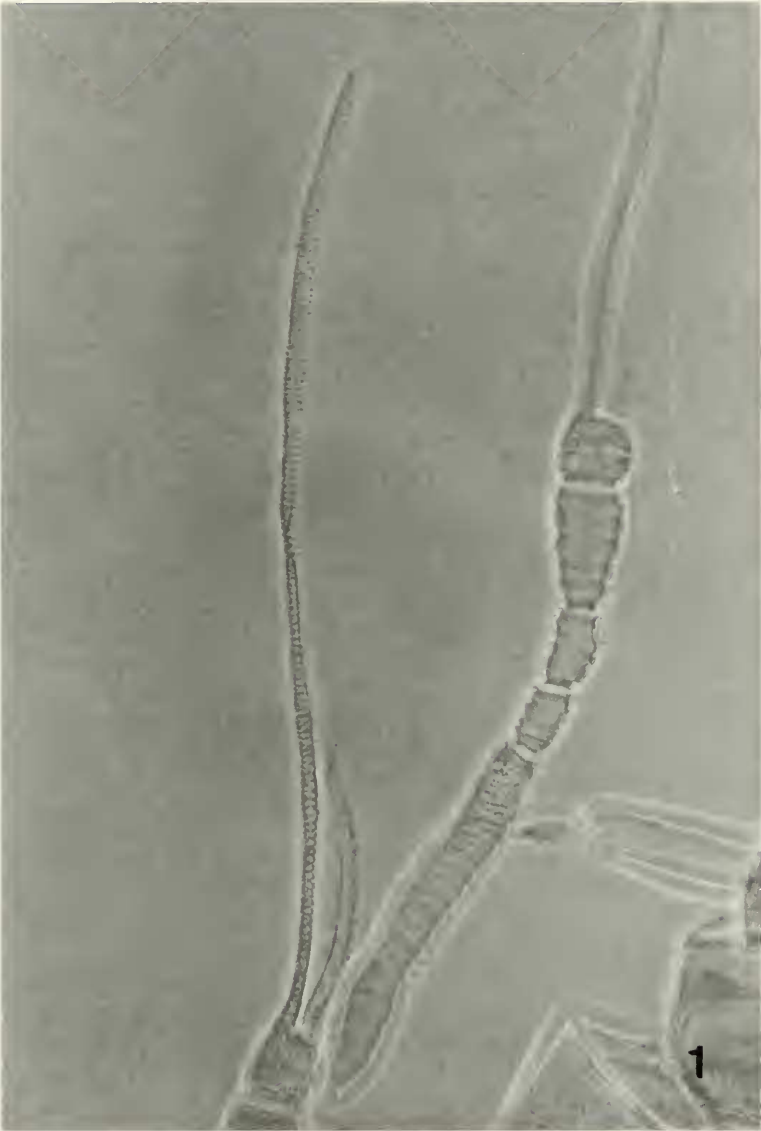


Fig. 1. *Aleurocybotus occiduus*, photos of antennae and foot of adult male. Antenna on left showing base of segment VII, one complete and one broken filament; antenna on right showing segments III-VI, base of segment VII, most of one filament, and most of the other filament out of focus; second tarsal claw pointing toward segment III of the latter antenna; portions of body derm below on right.

Lingula spatulate, extending beyond operculum, contained in orifice. Caudal furrow extending from orifice to posterior body margin.

Venter: Colorless, membranous. Flat in young, swollen in mature pupal cases. Submarginal wax glands present. Distal rostral

segment as wide as long, with two or three pairs of minute setae. Antenna located laterad of legs, longer in male than in female, extending to or well beyond posterior end of forelegs, ending in a fingerlike process. Adhesive sacs present. Tracheal folds absent. Thoracic, anterior and posterior ab-



Fig. 2. *Aleurocybotus occiduus*, second tarsus, claw with seta on left, claw-shaped tarsal appendage on right.

dominal spiracles present. Foreleg and middle leg sometimes reduced in size. Ventral abdominal setae present.

Species included.—*Aleurocybotus graminicola* (Quaintance and Baker) (1914, 1917) *Aleurocybotus occiduus* Russell (1964), Poinar (1965).

Discussion.—Quaintance (1899) did not designate a primary type for *Aleurodes graminicola*; thus, the type series consists of syntypes. I here designate as lectotype a slide containing a single female pupal case that is labeled as follows: “*Aleurocybotus/graminicola* (Q.)/On grass/Lake City, Fla./July 25, 1898/Q 6775 Prof. Ralfs” which is deposited in the USNM collection. In addition, there are five paralectotype slides containing three female pupal cases, two male pupal cases, and two adult males (USNM). Please note that the collection date given in Quaintance (1899) is July 24, 1898 rather than July 25; the correct spelling for the collector is Professor Rolfs.

Antennae similar to those described for pupal cases of *Aleurocybotus* exist in other genera. *Aleurolobus graminicola* Bink-Moenen (1983), an Old World species, is an example. Because adults of the species are not known, the relationships of the species are uncertain.

Species of *Aleurocybotus* occur on Gramineae and occasionally on Cyperaceae.

They are found on both surfaces of the leaves and on spikelets and stems when abundant.

Vasdaavidius Russell, new genus

Type species.—*Aleurocybotus indicus* David and Subramaniam (1976).

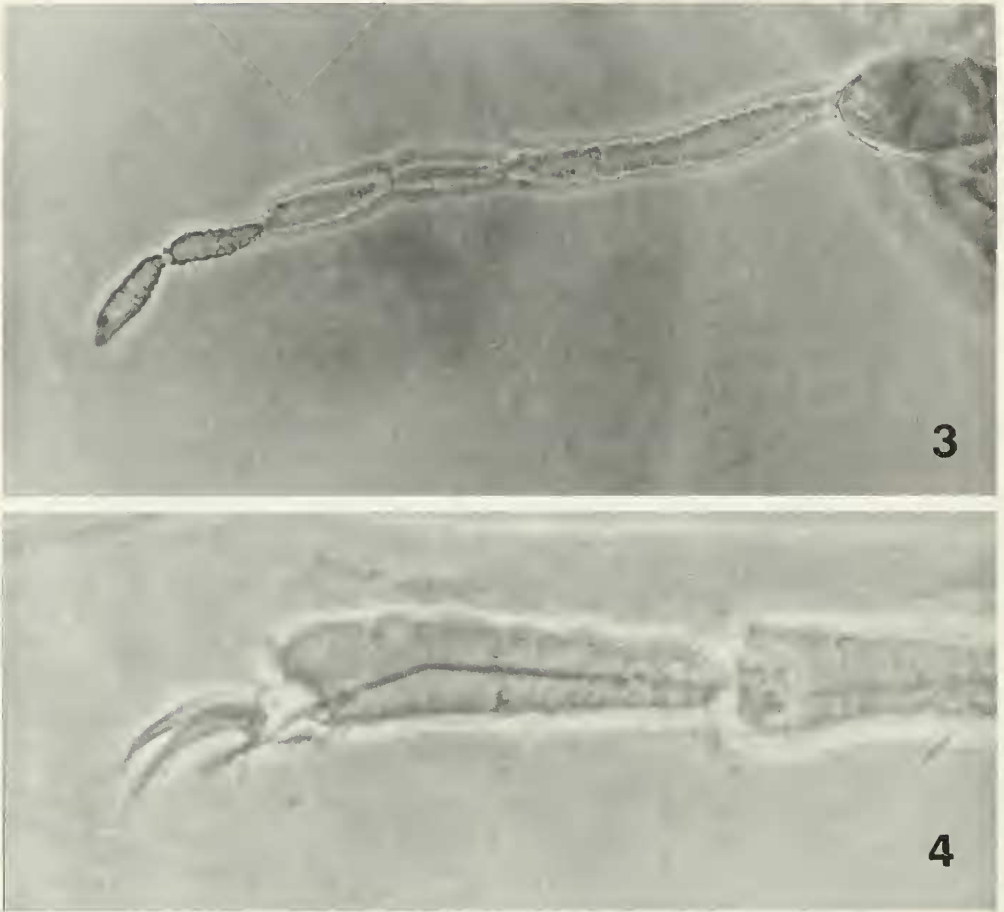
Female larger than male.

Adults.—Body slender, pale yellow or dorsum tinged with brown.

Head: Each compound eye divided by a narrow space; facets nearly identical in size and shape. An ocellus adjacent to margin of upper part of each compound eye. Distal rostral segment as wide as long, with two or three pairs of minute setae near apex and a pair sometimes near base. Antennal segment III longer than longest of subequal segments IV–VII, segment VII blunt apically (Fig. 3); one or more segments with a sensorium.

Thorax: Wings pale with dark areas, radial sector present. Legs with coxae, trochanters, femora, tibiae and two-segmented tarsi; hind tibia with a row of setae; foot with two similar, smooth claws, with a paronychium between claws (Fig. 4).

Abdomen: Area around vasiform orifice slightly sclerotic. Vasiform orifice circular, posterior end closed. Operculum wider than long. Lingula widest at base, then slender and spatulate, extending beyond orifice.



Figs. 3-4. *Vasdavidius indicus*. photos of antenna and foot, adult male. 3, Antennal segments III-VII. 4, Second tarsus, claws and paronychium.

Valves of female ovipositor elongate, sharply pointed apically. Claspers of male with a bulge dorsally near base, curved mesad, relatively broad, apices pointed, with several setae. Aedeagus fairly slender toward apex.

Pupal case.—Pale yellow, dorsum often with brown median area, or colorless. Elliptical or subelliptical in outline. Colorless or white wax on dorsum and venter; translucent white wax encircling swollen venter of mature pupal case.

Margin: Dentate. Anterior and posterior setae present, or anterior pair not observed. Thoracic tracheal pores absent.

Dorsum: Smooth or slightly sculptured, membranous or lightly sclerotized, flat or

with a median rachis on abdomen. Submedian depressions and pockets present. Eight segments present in median area of abdomen. Median and transverse molting sutures reaching body margin, transverse suture curved slightly caudad from its midpoint, recurved and ending at a point slightly anterior to its midpoint. Disk pores and associated porettes present. Cephalic, first and eighth abdominal and caudal setae present; thirteen to sixteen submarginal, subdorsal or submedian setae present. Vasiform orifice elongate cordate or triangular, posterior end closed. Operculum usually wider than long. Lingula spatulate, extending beyond operculum, contained in orifice.

Caudal furrow extending from orifice to posterior body margin.

Venter: Colorless, membranous. Flat in young, swollen in mature pupal cases. Distal rostral segment as wide as long, with two pairs of minute setae. Antenna located underneath or partly laterad of foreleg, not extending posterior to foreleg, ending in a short stub, length equal in male and female. Adhesive sacs present. Thoracic tracheal folds absent. Foreleg sometimes reduced in size. Thoracic, anterior and posterior abdominal spiracles present. Ventral abdominal setae present.

Discussion.—The pupal case of *Vasdividius* is distinguished from the pupal cases of other genera by the following combination of characters: Dorsum pale, often tinged with yellow or brown. Venter colorless. Body elliptical or subelliptical in outline. Margin dentate, thoracic tracheal pores absent. Subdorsum not separated from dorsal disk. Submargin or subdorsum usually with eleven to sixteen pairs of setae. Vasiform orifice subcordate or subtriangular, longer than wide, closed at posterior end. Operculum wider than long, lingula spatulate, extending beyond operculum, contained in orifice. Caudal furrow extending from orifice to posterior body margin. Antennae underneath or partially laterad of forelegs, not extending posterior of forelegs. Thoracic tracheal folds absent.

Species included.—*Vasdividius indicus* (David and Subramaniam) (1976), **new combination**; *Vasdividius concursus* (Ko in Ko, Wu and Chou) (1998), **new combination**; *Vasdividius miscanthus* (Ko in Ko, Wu and Chou) (1998), **new combination**; *Vasdividius cobarensis* (Martin) (1999), **new combination**; *Vasdividius setiferus* (Quaintance and Baker) (1917), **new combination**.

The species *Vasdividius concursus* and *V. miscanthus* are typical of *Vasdividius*. The species *V. cobarensis* and *V. setiferus* are not typical of the genus and future studies may place them differently. They do not have some of the characters of *Aleurocy-*

botus. The characters of the pupal case of *Aleurocybotus* include: the shape of the vasiform orifice which is longer than wide and is close to the posterior body margin; the lingula is spatulate; and there is a caudal furrow. The unusual characters of *Vasdividius cobarensis* and *V. setiferus* are as follows: *V. cobarensis* has a submarginal band of deep creases; *V. setiferus* has 15 or 16 pairs of vasiform setae instead of the slender setae of other species; in both *V. cobarensis* and *V. setiferus* the vasiform orifice is short cordate or subcircular and it is located more than its length from the posterior body margin; each has a lingula that is short and enlarged at the end; neither species has a caudal furrow. When Cohic (1968) described *Aleyrodes millettiae*, he stated that the species was not typical of *Aleyrodes*. Bink-Moenen (1983) transferred *Aleyrodes millettiae* to the *Aleurocybotus setiferus* group of species. Characteristics of the vasiform orifice, operculum, lingula and caudal furrow separate *Aleyrodes millettiae* from species of both *Aleurocybotus* and *Vasdividius*. Additionally, *Aleyrodes millettiae* has not been reported on Gramineae, the typical host family of *Aleurocybotus* and *Vasdividius*. I suggest that this species be returned to *Aleyrodes* as listed by Mound and Halsey (1978) in their catalog of Aleyrodidae.

Williams and Diop (1981) reported *V. indicus* to be a serious pest on rice in west Africa.

Etymology.—The name *Vasdividius* honors Dr. B. Vasantharaj David, eminent Indian entomologist, who has contributed greatly to the knowledge of whiteflies of southern Asia; the gender is masculine.

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